

REMARKS

Applicants respectfully acknowledge receipt of the Final Office Action mailed February 17, 2009.

Applicants would like to thank the Examiner for conducting a telephonic interview with Applicants' representatives on April 10, 2009. During the interview, Applicants' representatives discussed independent claim 1 and the *Halman et al.* reference. Specifically, Applicants' representatives focused the discussion on adding a new limitation to independent claim 1 directed toward a volume percentage density ratio of CF₄, N₂, and Ar. In response to the interview, Applicants submit herewith further arguments explaining how the pending claims are patentably distinguishable over the cited prior art.

In the Final Office Action, the Examiner rejected claims 1-5 and 14 under 35 U.S.C. § 103(a) as being unpatentable over *Halman et al.* (U.S. Patent No. 5,658,425) in view of *Li et al.* (U.S. Patent No. 6,284,149).

By this Amendment, Applicants propose to amend claims 1 and 14. Upon entry of this Amendment, claims 1-5 and 14 will remain pending. Of these claims, claims 1 and 14 are independent.

Based on the foregoing amendments, Applicants traverse the rejection above and respectfully request reconsideration for at least the reasons that follow.

I. 35 U.S.C. § 103(a) REJECTION

Claims 1-5 and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Halman* in view of *Li*. Applicants respectfully disagree with the Examiner's arguments and conclusions and submit that independent claims 1 and 14

are patentably distinguishable over *Halman* and *Li* at least for the reasons described below.

In order to establish a *prima facie* case of obviousness under 35 U.S.C. §103(a), the prior art reference (separately or in combination) must teach or suggest all the claim limitations. See M.P.E.P. § 2142, 8th Ed., Rev. 5 (August 2006). “[I]n formulating a rejection under 35 U.S.C. § 103(a) based upon a combination of prior art elements, it remains necessary to identify the reason why a person of ordinary skill in the art would have combined the prior art elements in the manner claimed.” *USPTO Memorandum* from Margaret A. Focarino, Deputy Commissioner for Patent Operations, May 3, 2007, p. 2. “[T]he analysis supporting a rejection ... should be made explicit” and it is “important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the [prior art] elements in the manner claimed.” *Id.* (citing *KSR Int’l Co. v. Teleflex, Inc.*, No. 04-1350 (U.S. Apr. 30, 2007)).

Halman appears to disclose a process for etching a silicon oxide, such as silicon dioxide, or oxynitride. The process includes etching a silicon oxide layer to expose an underlying electrically conductive titanium silicide layer and provide a contact opening extending through the silicon oxide layer to the electrically conductive titanium silicide layer. The etching is performed by exposing the silicon oxide layer to an etching gas. The etching gas includes a fluoride-containing gas and a passivating nitrogen gas. (*Halman*, Abstract). Furthermore, *Halman* discloses that “the etching gas can include an effective amount up to 5 volume % N₂, 75 to 80 volume % Ar, about 8 volume % CF₄ . . .” (*Id.* at col. 4, ll. 40-42). “Although there is no upper limit on the amount of nitrogen which can be added to the gas due to the highly reactive nature of the nitrogen

... , the maximum amount of nitrogen should be controlled to prevent the equipment from wearing out and/or showing the etching of the silicon dioxide layer to an undesirable level." (*Halman*, col. 4, ll. 52-58).

However, as admitted by the Examiner, "*Halman* does not teach using between 1 and 4 times as much N_2 as CF_4 ." (*Final Office Action*, p. 4). *Halman* also fails to teach or suggest "wherein a volume percentage density ratio of CF_4 , N_2 , and Ar is within a range: $1:1:6 \leq \text{vol. \% of } CF_4 : \text{vol. \% of } N_2 : \text{vol. \% of Ar} \leq 1:4:6$," as recited in independent claim 1, and similarly independent claim 14.

As disclosed in Applicants' specification on page 13, lines 6-30, "an etching process is implemented by adjusting the flow rate ratio of CF_4 , N_2 , and Ar, respectively at (a) 50:200:300, (b) 50:100:300 and (c) 50:50:300, to form contact holes at the layer insulating film of the wafer W . . . [T]he flow rate ratio (b) $CF_4:N_2 = 50:100 = 1:2$ achieves the most desirable results, . . . the flow rate ratio is set essentially within a range of $1 \leq (N_2 \text{ flow rate} / CF_4 \text{ flow rate}) \leq 4$." For the flow rate ratios represented in example (b) above, the volume percentage (vol% (density)) of CF_4 is essentially **11%** (or 50/450), the volume percentage (vol% (density)) of N_2 is essentially **22 vol%** (or 100/450), and volume percentage (vol% (density)) of Ar is essentially **67 vol%** (or 300/450).

Accordingly, in the present invention, the claimed volume percentage of CF_4 (11%) is greater than that disclosed in *Halman* (about 8 volume % CF_4); the claimed volume percentage of N_2 (22%) is approximately four times greater than that disclosed in *Halman* ("the etching gas can include an effective amount up to 5 volume % N_2 . . ." Col. 4, ll. 40-41); and the claimed volume percentage of Ar (67%) is less than

that disclosed in *Halman* (75 to 80 volume % Ar). Thus, *Halman* fails to teach or suggest the claimed volume percentages of CF₄, N₂, and Ar and the corresponding ratios. The incomparably larger flow rate and vol% of N₂ in the present invention is due to the focus on improvements in the selectivity and in the etching shape; whereas in *Halman*, the focus is to prevent over-etching.

Thus, in order to cure the deficiencies of *Halman*, the Examiner relies on *Li* for its alleged disclosure of "adding a substantial amount of N₂ to a fluorocarbon based plasma etching of Si-containing organic layer . . ." (*Final Office Action*, p. 4).

Li appears to disclose a plasma etching process for etching a carbon-based low-k dielectric layer in a multi-layer inter-level dielectric. The low-k dielectric may be BCB, which contains about 4% silicon, the remainder being carbon, hydrogen, and a little oxygen. The BCB etch uses an etching gas of oxygen, a fluoro carbon, and nitrogen, but no argon (emphasis added). (*Li*, Abstract). The multi-layer inter-level dielectric includes a substrate 10, a lower stop layer 14, a low-k lower dielectric layer 16, an upper stop layer 18, a low-k upper dielectric layer 20, and a hard mask layer 42. (*Id.* at col. 6, line 56 - col. 7, line 31).

Li, however, fails to explicitly teach or suggest "wherein a volume percentage density ratio of CF₄, N₂, and Ar is within a range: $1:1:6 \leq \text{vol. \% of CF}_4 : \text{vol. \% of N}_2 : \text{vol. \% of Ar} \leq 1:4:6$," as recited in independent claim 1, and similarly independent claim 14.

Accordingly, with respect to independent claims 1 and 14, *Halman* and *Li* fail to teach or suggest the claimed combination, including, *inter alia*:

introducing a processing gas into the airtight processing chamber, the processing gas containing at least CF₄, N₂, and Ar; . . .

wherein a volume percentage density ratio of CF₄, N₂, and Ar is within a range: $1:1:6 \leq \text{vol. \% of CF}_4 : \text{vol. \% of N}_2 : \text{vol. \% of Ar} \leq 1:4:6$.

For at least the foregoing reasons, a *prima facie* case of obviousness has not been established with respect to independent claims 1 and 14. Accordingly, independent claims 1 and 14, and claims 2-5 that depend from claim 1, are patentable over *Halman* and *Li*. Applicants therefore request that the rejection of claims 1-5 and 14 under 35 U.S.C. § 103(a) be withdrawn.

II. CONCLUSION

Applicants respectfully request that this Amendment under 37 C.F.R. § 1.116 be entered by the Examiner, placing claims 1-5 and 14 in condition for allowance. Applicants submit that the proposed amendments of claims 1 and 14 do not raise new issues or necessitate the undertaking of any additional search of the art by the Examiner, since all of the elements and their relationships claimed were either earlier claimed or inherent in the claims as examined. Therefore, this Amendment should allow for immediate action by the Examiner.

Furthermore, Applicants respectfully point out that the final action by the Examiner presented some new arguments as to the application of the art against Applicants' invention. It is respectfully submitted that the entering of the Amendment

would allow the Applicants to reply to the final rejections and place the application in condition for allowance.

Finally, Applicants submit that the entry of the amendment would place the application in better form for appeal, should the Examiner dispute the patentability of the pending claims.

In view of the foregoing remarks, Applicants submit that this claimed invention, as amended, is neither anticipated nor rendered obvious in view of the prior art references cited against this application. Applicants therefore request the entry of this Amendment, the Examiner's reconsideration and reexamination of the application, and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to our Deposit Account 06-0916.

Respectfully submitted,

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